Claims

[c1] 1.A method for protecting an article from a high temperature, oxidative environment, said method comprising:
providing a substrate;
providing an ion plasma deposition target, said target comprising from about 2 atom percent to about 25 atom percent chromium, and the balance comprising aluminum; and
depositing a protective coating onto said substrate using said target in an ion plasma deposition process.

[c2] 2.The method of claim 1, wherein providing said target comprises providing a target further comprising a material selected from the group consisting of zirconium, hafnium, tantalum, silicon, yttrium, titanium, lanthanum, cerium, carbon, boron, and combinations thereof.

[c3] 3.The method of claim 2, wherein providing said target comprises providing a target further comprising up to about 4 atom percent of a material selected from the group consisting of zirconium, hafnium, tantalum, silicon, yttrium, titanium, lanthanum, cerium, and combinations thereof; and up to about 0.2 percent of a material selected from the group consisting of carbon, boron, and combinations thereof.

[c4] 4.The method of claim 3, wherein providing said target comprises providing a target comprising
about 9 atom percent chromium,
about 1 atom percent zirconium, and
the balance comprising aluminum.

[c5] 5.The method of claim 3, wherein providing said target comprises providing a target comprising
about 9 atom percent chromium,
about 1 atom percent zirconium,
about 2 atom percent tantalum, and
the balance comprising aluminum.

[c6] 6.The method of claim 3, wherein providing said target comprises providing a target comprising
about 9 atom percent chromium,
about 1.5 atom percent hafnium,
about 1.5 atom percent silicon, and
the balance comprising aluminum.

[c7] 7.The method of claim 1, further comprising:
coating said substrate with a metal layer prior to depositing said protective coating.

[c8] 8.The method of claim 7, wherein coating said substrate with a metal layer comprises coating said substrate with a metal layer comprising at least one of platinum, palladium, nickel, and cobalt.

[c9] 9.The method of claim 8, further comprising:
heat treating said substrate after coating said substrate with said metal layer.

[c10] 10.The method of claim 9, wherein heat treating comprises heating said substrate to a temperature in the range from about 900 ° C to about 1200 ° C for a time in the range from about 30 minutes to about 8 hours.

[c11] 11.The method of claim7, wherein coating said substrate with a metal layer comprises coating with a layer having a thickness in the range from about 2 micrometers to about 25 micrometers.

[c12] 12.The method of claim11, wherein coating said substrate with a metal layer comprises coating with a layer having a thickness in the range from about 2 micrometers to about 6 micrometers.

[c13] 13.The method of claim 1, further comprising heat treating said substrate after depositing said protective coating.

[c14] 14.The method of claim 13, wherein heat treating comprises heating said substrate to a temperature in the range from about 700 ° C to about 1200 ° C for a time in the range from about 30 minutes to about 8 hours.

[c15] 15.The method of claim 1, wherein providing said substrate comprises providing at least one of a nickel alloy, an iron alloy, and a cobalt alloy.

[c16] 16.The method of claim 15, wherein providing said substrate comprises providing a superalloy.

[c17] 17.The method of claim 16, wherein providing said superalloy comprises providing a component for service in a hot gas path of a gas turbine assembly.

[c18] 18.The method of claim 1, wherein providing a substrate comprises providing a substrate comprising at least one coating.

[c19] 19.The method of claim 1, wherein providing said ion plasma deposition target comprises providing a target manufactured using at least one of casting and powder metallurgy processing.

[c20] 20.The method of claim 1, wherein depositing said protective coating onto said substrate further comprises applying a negative potential bias to said substrate.

[c21] 21.The method of claim 20, wherein applying said negative potential bias comprises applying a potential bias in the range from about 10 volts to about 1000 volts.

[c22] 22.The method of claim 21, wherein applying said negative potential bias comprises applying a potential bias in the range from about 50 volts to about 250 volts.

[c23] 23.The method of claim 1, wherein depositing said protective coating onto said substrate further comprises grounding said substrate.

[c24] 24.The method of claim1, wherein depositing said protective coating comprises depositing a protective coating having a thickness in the range from about 5 micrometers to about 250 micrometers.

[c25] 25.The method of claim 24, wherein depositing said protective coating comprises depositing a protective coating having a thickness in the range from about 25 micrometers to about 75 micrometers.

[c26] 26.The method of claim 1, further comprising coating said protective layer with a thermal barrier coating.

[c27] 27.The method of claim 26, wherein coating said protective layer with a thermal barrier coating comprises coating said protective layer with a thermal barrier coating comprising yttria-stabilized zirconia.

[c28] 28.The method of claim 1, wherein depositing said protective coating comprises forming a protective coating comprising at least 80 volume percent of a single phase.

[c29] 29.The method of claim 28, wherein depositing said protective coating comprises forming a protective coating comprising at least 80 volume percent of a B2-structured aluminide intermetallic phase.

[c30] 30.The method of claim 1, wherein depositing said protective coating comprises forming a protective coating comprising at least two phases.

[c31] 31.The method of claim 30, wherein depositing said protective coating comprises forming a protective coating comprising a B2-structured aluminide intermetallic phase and platinum aluminide ($PtAl_2$).

[c32] 32.A method for protecting an article from a high temperature, oxidative environment, said method comprising:
providing a substrate comprising a nickel-based superalloy;
providing an ion plasma deposition target, said target comprising
from about 2 atom percent to about 25 atom percent chromium,
up to about 4 atom percent of a material selected from the group consisting of zirconium, hafnium, tantalum, silicon, yttrium, titanium, lanthanum, cerium, and combinations thereof,
up to about 0.2 percent of a material selected from the group consisting of carbon, boron, and combinations thereof, and
the balance comprising aluminum;
depositing a protective coating onto said substrate using said target in an ion plasma deposition process, wherein a negative potential bias is applied to said substrate during deposition of said protective coating; and

heat treating said substrate after depositing said protective coating;
wherein after heat treating, said protective coating comprises a B2-structured aluminide intermetallic phase.

[c33] 33.The method of claim 32, further comprising:
coating said substrate with a metal layer comprising at least one of platinum, palladium, nickel, and cobalt; and
heat treating said substrate after coating said substrate with said metal layer.

[c34] 34.An alloy comprising:
from about 2 atom percent to about 25 atom percent chromium;
up to about 4 atom percent of a material selected from the group consisting of zirconium, hafnium, tantalum, silicon, yttrium, titanium, lanthanum, cerium, and combinations thereof;
up to about 0.2 percent of a material selected from the group consisting of carbon, boron, and combinations thereof; and
the balance comprising aluminum.

[c35] 35.The alloy of claim 34, wherein said alloy comprises:
about 9 atom percent chromium;
about 1 atom percent zirconium; and
the balance comprises aluminum.

[c36] 36.The alloy of claim 34, wherein said alloy comprises:
about 9 atom percent chromium;
about 1 atom percent zirconium;
about 2 atom percent tantalum; and
the balance comprises aluminum.

[c37] 37.The alloy of claim 34, wherein said alloy comprises:
about 9 atom percent chromium;
about 1.5 atom percent hafnium;
about 1.5 atom percent silicon; and
the balance comprises aluminum.

[c38] 38.A target for use in an ion plasma deposition process, said target comprising:

an alloy comprising
from about 2 atom percent to about 25 atom percent chromium,
up to about 4 atom percent of a material selected from the group consisting of zirconium, hafnium, tantalum, silicon, yttrium, titanium, lanthanum, cerium, and combinations thereof,
up to about 0.2 percent of a material selected from the group consisting of carbon, boron, and combinations thereof, and
the balance comprising aluminum.

[c39] 39.An article for use in a high temperature, oxidative environment, comprising:
a substrate; and
a coating disposed over said substrate, said coating comprising
from about 2 atom percent to about 25 atom percent chromium,
up to about 4 atom percent of a material selected from the group consisting of zirconium, hafnium, tantalum, silicon, yttrium, titanium, lanthanum, cerium, and combinations thereof,
up to about 0.2 percent of a material selected from the group consisting of carbon, boron, and combinations thereof, and
the balance comprising aluminum.